

The Chaining Force

A Hypothesis on a Fundamental Relational Force
Operating Across All Physical Scales

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Abstract

We propose the existence of a fundamental force — the *Chaining Force* — which drives matter toward increasingly complex structures across all physical scales, from atomic assemblies to stellar formation. Unlike classical forces, the Chaining Force has no fixed direction vector; it operates through relational chaining between matter elements, with a global tendency toward structural ascent. We argue that stellar formation is its local success, black holes are its local failure (caused by excessive accretion rate), and the known fundamental forces are its scale-dependent manifestations. This hypothesis is placed within the framework of the Relational Emergence Complexity Theory (RECT) [1], where the Chaining Force is identified as the physical expression of Axiom II — maximal relational complexity. All claims are speculative and clearly marked. This document establishes priority of the idea and invites formal verification.

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1 Motivation

Newton observed an apple falling. Gravity pulls downward — toward existing mass, toward the center.

But matter also *rises*. A dispersed cloud of hydrogen becomes a star. Simple atoms become complex molecules. Molecules become life. The trajectory of matter over cosmic time is not downward — it is toward greater structure, greater complexity, greater connection.

This ascending tendency is not explained by gravity alone. Gravity explains why matter clumps. It does not explain why matter *organises* — why it forms stable, complex, interconnected structures rather than simply collapsing into undifferentiated mass.

We propose that this ascending tendency is the expression of a fundamental force — the **Chaining Force** — which operates at all scales, from atoms to galaxies, through relational chaining.

2 Definition and Properties

Definition 1 (The Chaining Force). *The Chaining Force $\mathbf{F}_c$ is a fundamental physical force with the following properties:*

- (i) **Non-vectorial.** $\mathbf{F}_c$ has no fixed spatial direction. Its trajectory is locally irregular — zigzag, curved — but globally oriented toward increasing structural complexity.
- (ii) **Relational.** $\mathbf{F}_c$ exists between matter elements, not within them. It requires at least two elements to manifest.
- (iii) **Scalable.** The same force operates at all scales: atomic, molecular, planetary, stellar, galactic.
- (iv) **Chaining.** $\mathbf{F}_c$ acts by successive links — atom to atom, molecule to molecule, planet to planet. Each link enables the next.
- (v) **Slow.** The global ascending effect of $\mathbf{F}_c$ operates on timescales of billions of years. Locally, gravity dominates in seconds. Globally, $\mathbf{F}_c$ dominates over cosmic time.
- (vi) **Universal.** $\mathbf{F}_c$ is present at all scales and in all configurations of matter — including inside black holes.

Remark 1. *The non-vectorial nature of $\mathbf{F}_c$ distinguishes it from all four known fundamental forces (gravity, electromagnetism, strong nuclear, weak nuclear), which are all described by vector or tensor fields with definite local directions. $\mathbf{F}_c$ is better described as a tendency in the space of configurations than as a force in physical space.*

3 The Chaining Force and Stellar Formation

3.1 Stellar formation as local success

A star forms when a dispersed cloud of atoms progressively accretes toward a central point. The key word is *progressively* — the atoms arrive at a rate that allows the forming structure to organise, stabilise, and sustain nuclear fusion.

Proposition 1 (Stellar formation). *A stable star forms when the accretion rate $\dot{M}$ satisfies:*

$$\dot{M} < \dot{M}_{\text{crit}}$$

where $\dot{M}_{\text{crit}}$ is the critical accretion rate above which the forming structure cannot organise fast enough to sustain itself. Stellar formation is the local success of $\mathbf{F}_c$ — atoms arrive progressively, chain together, and form a stable complex structure. *[Sketched]* (the identification of $\dot{M}_{\text{crit}}$ with a complexity threshold requires further formalisation)

3.2 Black holes as local failure

Proposition 2 (Black hole formation). *A black hole forms when $\dot{M} \geq \dot{M}_{\text{crit}}$ — atoms arrive too fast for the structure to organise. The Chaining Force is present but cannot operate: the relational chaining cannot keep pace with the accretion. The structure collapses rather than organises.*

Inside a black hole, $\mathbf{F}_c$ persists — but it operates on the compressed matter without the possibility of outward structural expression. *[Sketched]* (the internal dynamics of $\mathbf{F}_c$ inside a black hole are entirely open)

Remark 2. *This interpretation inverts the standard narrative. Classical physics says: a black hole is a victory of gravity. The Chaining Force hypothesis says: a black hole is a failure of complexity — matter that could not organise in time.*

4 Scale Invariance and the Chaining Hierarchy

The Chaining Force operates at all scales through successive links:

$$\text{quarks} \xrightarrow{\mathbf{F}_c} \text{atoms} \xrightarrow{\mathbf{F}_c} \text{molecules} \xrightarrow{\mathbf{F}_c} \text{dust} \xrightarrow{\mathbf{F}_c} \text{planets} \xrightarrow{\mathbf{F}_c} \text{stars} \xrightarrow{\mathbf{F}_c} \text{galaxies} \xrightarrow{\mathbf{F}_c} \dots$$

Each level is a stable structure that becomes the *building block* of the next level. This is the chaining: not a single leap from atom to galaxy, but a succession of local successes, each enabling the next.

Conjecture 1 (Universality of chaining). *The known fundamental forces — gravity, electromagnetism, strong and weak nuclear forces — are scale-dependent manifestations of $\mathbf{F}_c$. Each operates dominantly at a specific scale:*

- *Strong nuclear force: $\mathbf{F}_c$ at the quark-nucleon scale*
- *Electromagnetism: $\mathbf{F}_c$ at the atomic-molecular scale*
- *Gravity: $\mathbf{F}_c$ at the planetary-stellar-galactic scale*

The apparent difference between these forces is a difference of scale, not of nature. [Open]

5 Connection to RECT

Within the framework of RECT [1], the Chaining Force has a natural interpretation.

RECT is built on two axioms. Axiom I states that the relational substrate $\mathcal{R}$ is self-consistent. Axiom II states that $\mathcal{R}$ maximises its relational complexity $\mathcal{C}(\mathcal{R}) = \#\mathcal{R}_{\text{irr}}$.

Proposition 3 (Chaining Force as Axiom II). *The Chaining Force $\mathbf{F}_c$ is the physical expression of Axiom II operating at the level of matter configurations in $\mathcal{M}$.*

A dispersed cloud of atoms has low $\mathcal{C}(\mathcal{R})$ — few irreducible relations between elements. A star has high $\mathcal{C}(\mathcal{R})$ — millions of atoms in sustained nuclear interaction, each involved in irreducible relations with many others.

*Axiom II selects the stellar configuration over the dispersed configuration. This selection pressure, operating through the geometry of $\mathcal{M}$, is what we observe as $\mathbf{F}_c$. **[Sketched]** (the precise mapping between $\mathcal{C}(\mathcal{R})$ and accretion dynamics requires formalisation)*

Remark 3. *In this interpretation:*

- *Gravity is $\mathbf{G}(\mathcal{R})$ — the geometric projection of $\mathcal{R}$ onto $\mathcal{M}$. It pulls matter together locally.*
- *The Chaining Force is Axiom II operating globally — it selects which configurations matter settles into over cosmic time.*
- *The two are not in competition. Gravity provides the local mechanism. The Chaining Force provides the global direction.*

6 Open Problems

1. **Formalisation of $\dot{M}_{\text{crit}}$.** Define the critical accretion rate as a function of $\mathcal{C}(\mathcal{R})$. Show that $\dot{M}_{\text{crit}}$ corresponds to a known astrophysical threshold (e.g. the Eddington luminosity limit).
2. **Unification conjecture.** Conjecture 1 — the four known forces as scale-dependent manifestations of $\mathbf{F}_c$ — requires a mathematical framework connecting the coupling constants of each force to the complexity density ρ_c at each scale.
3. **Black hole interior.** What does $\mathbf{F}_c$ do inside a black hole? Does it drive matter toward a new configuration beyond the singularity?
4. **Cosmic rays as carriers.** Cosmic rays are high-energy particles travelling across the universe. Are they carriers of $\mathbf{F}_c$ — the physical medium through which the Chaining Force propagates across scales?
5. **Experimental signature.** What observable prediction distinguishes $\mathbf{F}_c$ from the combined effect of the four known forces? A candidate: the statistical distribution of stellar masses should show a bias toward complexity-maximising configurations beyond what gravity alone predicts.

7 Summary

Concept	Classical physics	Chaining Force hypothesis
Gravity	Pulls matter down	Local mechanism of $\mathbf{F}_c$
Star formation	Gravitational collapse	Local success of $\mathbf{F}_c$
Black hole	Victory of gravity	Failure of complexity
4 fundamental forces	Distinct, irreducible	Manifestations of $\mathbf{F}_c$
Arrow of time	Thermodynamic	Complexity ascent via $\mathbf{F}_c$

The central claim of this paper is simple:

Matter does not only fall. It rises — slowly, through relational chaining, toward greater complexity. This rising is not metaphor. It is a physical tendency, operating at all scales, over billions of years. The Chaining Force is its name.

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References

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